

Pupae of Japanese Sesiidae (Lepidoptera)

Masanao NAKAMURA

Ubumi 4971-1, Yutocho, Nishi-ku, Hamamatsu, 431-0102 Japan

Abstract The pupae of 19 species belonging to 11 genera of Japanese Sesiidae are described and classified. From the characters, these pupae are divided into two subfamilies, Tinthiinae and Sesiinae and the former into two tribes, Tinthiini and Pennisetiini, and the latter into three tribes, Sesiini, Paranthrenini and Melittiini. *Nokona* Matsumura is constituted from three groups and a new subgenus *Aritasesia* nov. erected to contain *pernix* Leech and *rubra* Arita and Toševski.

Key words Sesiidae, pupa, classification, phylogeny, description, Japan, *Nokona* (*Aritasesia*) subgenus nov.

Of works on the sesiid pupa, Mosher (1916) first gave a discriminating key for the six North American genera, next Fibiger and Kristensen (1974) noted a brief account of the features of four genera of northern European moths, recently Patočka (1987) submitted short descriptions and a classificatory key for eight genera of central European pupae and Common (1990) showed a minute figure of *Synanthedon tipuliformis* Clerck from Australia.

The pupae of eleven genera of Japanese Sesiidae are described and classified in this paper. This material was reared from larvae collected in the field (Arita and Ikeda, 2000) and prepared specimens in spirits in Zoological Lab. of Meijo University, Nagoya. These specimens were offered to the author for investigation by courtesy of Prof. Y. Arita.

Common characters in Sesiid-pupa

More or less feeble except for Melittiini; longitudinal fusiform or cylindrical but fusiform in Paranthrenini and Melittiini. 3rd to 7th abdominal segments movable in ♂ and to 6th in ♀. Prominently acute frontal process (=gall or pupal case cutter) present on vertex; adfrontal suture present but often obscure; frontal piece of some species enclosed by carinated ragged ridge which is not seen in other families; fronto-clypeal suture always distinct; labial palpus large, noctuid-type; apex of maxillary palpus well visible between eye-piece and legs; caudal end of suture restricting eye-piece touching maxillary palpus, restricting suture between glazed and sculptured pieces unrecognized; antenna frequently clavate at apex in many genera; mandible somewhat large and restricting suture distinct; maxilla never reaching apex of wing except for *Synanthedon*, proximo-lateral corner never touching maxillary palpus in general; suture between pro- and mesothorax strikingly twisted near antenna and attached to caudal point of proximal margins of pro- and mesothoracic legs; spiracular callosity distinct and ragged in *Melittia* and *Macrocesia*; heavily sclerotized ridge of notaulix furrows on thorax; forewing very narrow, tapered to apex; hindwing hidden under forewing on 3rd or 4th abdominal segment but rarely extending narrowly to the abdominal ventro-meson; prothoracic leg reaching or not reaching tip of maxilla; mesothoracic legs extending to near apex of wing, occasionally meeting on meson in apical portion; metathoracic leg appearing large, especially huge in *Milisipepsis* and *Macrocesia longipes* (Moore); abdomen smooth;

*Taxonomic studies on the pupae of Japanese Lepidoptera-Heterocera XVII.

two rows of minute spines along cephalic and caudal margins on 2nd to 7th abdominal segments in ♂ and to 6th one in ♀, and one row along cephalic margin on 8th and 9th segments in ♂ but on 7th segment in ♀, but one row on 2nd segment in *Synanthedon* and exceptionally one additional row on 1st segment in *Toleria*; a row of thin claw-like thorns along cephalic margin on 6th–8th segments (Fig. 7a) only in the species of the nominotypical subgenus of *Nokona*; 8th abdominal spiracle vestigial and situated more dorsad than those of the other segments; some sclerotized scaly spines with a seta inserted at tip born around caudal dehiscence on 10th abdominal segment.

In this family, the larval anal leg does not heavily shrink in comparison with the anal shield at pupation and the 10th abdominal segment is formed incorporating the anal leg and anal shield, following which these parts are placed anteriorly and posteriorly in the pupa. Delgado Puchi (2005) recognized the presence of these two parts on the caudal end of the body in *Carmenta* spp. Consequently, a cremaster which attaches to the anal shield is not formed, and Fibiger and Kristensen's (1974) use of the term cremaster is incorrect. This phenomenon is conspicuously different from slightly higher families such as the Tortricidae. The scar of a separate line between the anal leg and anal shield corresponding to the "lateral groove" of the Geometridae etc. is often visible between the dorsal and ventral portions of the 10th segment (*vid.* Fig. 34). In some species, a small roughened area is present on the caudal end of the 10th segment (Figs 23, 35). Similar tissue is seen on the reverse side of the caudal end of the larval anal shield. This tissue is presumed to be the part bearing the anal tuft of the adult. Fundamentally, four pairs of heavy sclerotized scaly spines (=anal shield setae) are present on the dorsal area and some pairs of these spines (=anal leg setae) on the ventral part.

Mosher (*l. c.*) suggested that the pupa of the Sesiidae is somewhat allied to that of the Tortricidae in the number of movable abdominal segments (3rd–7th segments in ♂ and 3rd–6th in ♀). Beyond this, as pointed out above, both families are related distinctly in the possession of two clypeus setae instead of one frontal seta: however there are fundamental differences in the presence of a large frontal process, in the maxilla being longer than the prothoracic leg, in the position of suture between the pro- and mesothorax attaching to the antenna, in the sclerotized scaly spines on the 10th abdominal segment, in the absence of thoracic D1 seta and in the lack of an abdominal L2 seta etc.

These characters are closer to the Castniidae, relying on the figure shown by Common and Edwards (1981), although the pupa of *Synemon magnifica* Strand differs from sesiid pupae in the lack of a frontal process, the presence of two pairs of Cl setae, the bulging club of antenna and very slender prothoracic femur, the position of 8th abdominal spiracle, etc.

Chaetotaxy: Sesiid-pupae show a peculiar chaetotaxy *viz.* in the head, Af and Cl setae (there is no F-seta recognized in most families) are limited to one each (perhaps Af2 and Cl1 setae), except for the genera of Tinthiinae and *Melittia* in which Af and Cl setae are both doubled. The prothorax is without setae. Each of the meso- and metathorax have only one SD1 seta but in some genera there are no setae on the metathorax. The 2nd–7th abdominal segments all possess D1, SD1 and L1 setae, and the genera belonging to Tinthiinae and Paranthrenini of Sesiinae bear SV1 seta or SV1 and SV2 setae on the 4th–7th segments.

There have been no examples in the pupae of other families which have only SD seta instead of D seta on the thorax.

Phylogenetic relation of Japanese Sesiidae based on the pupa

The phylogeny for Japanese Sesiidae based on the pupa is shown in Fig. 1. Tinthiinae and

Sesiinae are easy distinguishable from each other by the presence or absence of the SD1 seta on the metathorax. However, Sesiini under Sesiinae seems to have some relationship with Tinthiinae in having a rugose ridge on the frons. In contrast, Melittini is situated at the opposite end to Sesiini in this subfamily. For example, even in the body shape, the former is weak and slim, while the latter is firm and bulging. Paranthrenini show characters intermediate to both tribes and include heterogeneous genera from *Paranthrene*, which is similar to Sesiini, to *Toleria* which is allied to Melittini. Only *Synanthedon* is unique in the maxilla reaching the apex of wing but is not placed in Synanthedonini in this paper.

This system, however, is nearly identical with the systematic catalogue of Pühringer and Kallies (2004) except for the following: 1. as mentioned above, *Synanthedon*, which is here included in the Sesiini was placed into the tribe Synanthedonini by them. 2. *Toleria*, which is placed in the Paranthrenini by the author, was treated as a member of the Cissuvorini by them.

A similar classificatory system has been published by Naumann (1971) but he considered *Toleria* together with *Sesia* as members of the Sesiini. However, the author places the pupa of *Toleria* with those of *Nokona* and *Paranthrene* in the Paranthrenini.

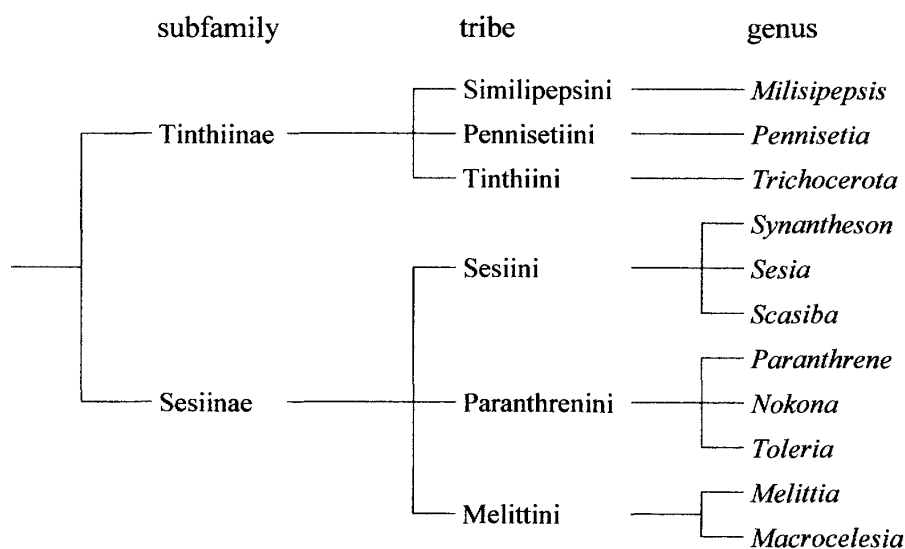


Fig. 1. Phylogenetic relation of Japanese Sesiidae based on pupal features.

Key to the genera

1. Tip of prothoracic leg attached to maxilla; conspicuous ridged notaulix furrow present on mesothorax; row of small spines present along cephalic margin of 7th abdominal segment; SD1 seta absent on metathorax; SV setae present on 4th–7th abdominal segmentsTinthiinae 2
- Tip of prothoracic leg unattached to maxilla; conspicuous ridged notaulix furrow absent on mesothorax; rows of small spines present along cephalic and caudal margins of 7th abdominal segment; SD1 seta present on metathorax; SV setae never present on abdominal segments except for ParanthreniniSesiinae 4
2. Cylindrical; both sides of frontal process never overhanging pterogoid; frons never enclosed with carinated rugose ridge; proximo-lateral corner of maxilla not touching maxillary palpus; mesothoracic legs never meeting on meson; metathoracic leg

- appearing long and reaching to 6th abdominal segment; row of small spines absent on 2nd abdominal segment; four pairs of scaly spines born around caudal dehiscence*Similipepsini Milisipepsis* Gorbunov and Arita
- Longitudinal fusiform; both sides of frontal process black, overhanging pterogoid; frons enclosed with carinated rugose ridge; proximo-lateral corner of maxilla touching maxillary palpus; mesothoracic legs meeting on meson in apical portion; metathoracic leg appearing short; row of small spines present on 2nd abdominal segment; five pairs of scaly spines born around caudal dehiscence.....3
3. A small spine present on frons ventro-meson; labial palpus small; maxilla reaching tip of prothoracic leg; one row of small spines present on 2nd abdominal segment; hindwing hidden under forewing on 3rd abdominal segment*Pennisetiini Pennisetia* Dehne
- A small spine never present on frons; labial palpus large; maxilla reaching far beyond tip of prothoracic leg; two rows of small spines present on 2nd abdominal segment; hindwing hidden under forewing on 4th abdominal segment*Tinhtiini Trichocerota* Hampson
4. Head with carinated rugose ridge restricting frontal area; small spine present on frons; maxilla reaching tip of mesothoracic leg; metathoracic leg appearing short*Sesiini* 5
- Head without carinated rugose ridge restricting frontal area; small spine absent on frons; maxilla reaching far beyond tip of mesothoracic leg; metathoracic leg appearing long7
5. Apex of frontal process protruding; a pair of small spines on frons; maxilla reaching apex of wing; forewing extending to 5th abdominal segment; rows of small spines never present along cephalic and caudal margins of 2nd abdominal segment; four pairs of scaly spines born on 10th abdominal segment.....*Synanthedon* Hübner
- Apex of frontal process turned upwards; a small spine present on frons; maxilla reaching two thirds of the way to apex of wing; forewing extending to 4th abdominal segment; rows of small spines present along cephalic and caudal margins of 2nd abdominal segment; four pairs of spines and some additional minute scaly spines on 10th abdominal segment.....6
6. A pair of minute spines present on frons; distal end of prothoracic legs never meeting on meson; six or more pairs of scaly spines born on ventral part of 10th abdominal segment*Scasiba* Matsumura
- Minute spines absent on frons; distal end of prothoracic legs meeting on meson; four pairs of scaly spines and two pairs of micro spines born on ventral part of 10th abdominal segment.....*Sesia* Fabricius
7. Frontal process inconspicuous; apical portion of maxilla never hidden under mesothoracic leg and exposed fully; antenna extending more than half way to apex of wing; maxilla fully visible to apex; spiracular callosity small; hindwing hidden under forewing on 3rd abdominal segment; 8th abdominal spiracle situated more dorsad; SV seta present on abdominal segments*Paranthrenini* 8
- Frontal process conspicuous; apical portion of maxilla progressively hidden under mesothoracic leg so that the portion exposed is tapering; antenna extending half the length to apex of wing; maxilla gradually narrowed towards apex and hidden under mesothoracic leg; spiracular callosity conspicuous; 8th abdominal spiracle situated in normal position; SV seta absent on abdominal segments*Melittiini* 11
8. Body thick; frontal process weakly prominent; frons becoming tetragonal and depressed; antenna ending far beyond tip of maxilla; forewing extending to 4th ab-

- dominal segment; hindwing hidden under forewing at cephalic margin of 3th abdominal segment; one SV seta present on 4th–7th abdominal segments9
- Body slender; frontal process strongly prominent; antenna ending slightly beyond tip of maxilla; hindwing hidden under forewing at caudal margin of 3rd abdominal segment; many vertical striations on 8th abdominal segment cephalo-ventrad; two SV setae present on 4th–7th abdominal segments10
9. A small hooked spine present on upper end of labial palpus; maxilla reaching five-eighth of the distance to apex of wing; hindwing hidden under forewing at caudal margin of 3rd abdominal segment; one row of small spines present on 1st abdominal segment; three pairs of spatulate spines on ventral part and two pairs of spines on dorsal part of 10th abdominal segment..... *Toleria* Walker
- A pair of small spines present on both sides of labral piece; maxilla reaching three-fourths the distance to apex of wing; hindwing visible to near apex of wing; row of small spines absent on 1st abdominal segment; four pairs of scaly spines on ventral part and two pairs of scaly spines on dorsal part of 10th abdominal segment*Nokona* Matsumura (*Aritasesia*)
10. Forewing extending to 4th abdominal segment; hindwing hidden under forewing at caudal margin of 3rd abdominal segment; a thin claw-like row of thorns present on 6th–8th abdominal segments ventrad; three pairs of scaly spines born around caudal dehiscence*Nokona* Matsumura (*s. str.*)
- Forewing extending to 5th abdominal segment; hindwing hidden under forewing at cephalic margin of 4th abdominal segment; thin claw-like row of thorns absent on 6th–8th abdominal segments ventrad; six pairs of scaly spines born around caudal dehiscence*Paranthrene* Hübner
11. Af1 and Af2 setae present on vertex; Cl1 and Cl2 setae present on frons; frontal process only slightly protruding; maxillary palpus touching antenna; proximal end of mesothoracic leg visible cephalad of that of prothoracic leg; hindwing visible to abdominal ventro-meson; relatively large spatulate spines born on 10th abdominal segment*Melittia* Hübner
- Af1 seta present on head; Cl1 seta present on frons; frontal process strongly protruding; maxillary palpus not touching antenna; proximal end of mesothoracic leg visible at same point as that of prothoracic leg; hindwing hidden under forewing at caudal margin of 4th abdominal segment; minute spines born on 10th abdominal segment.....*Macrocesia* Hampson

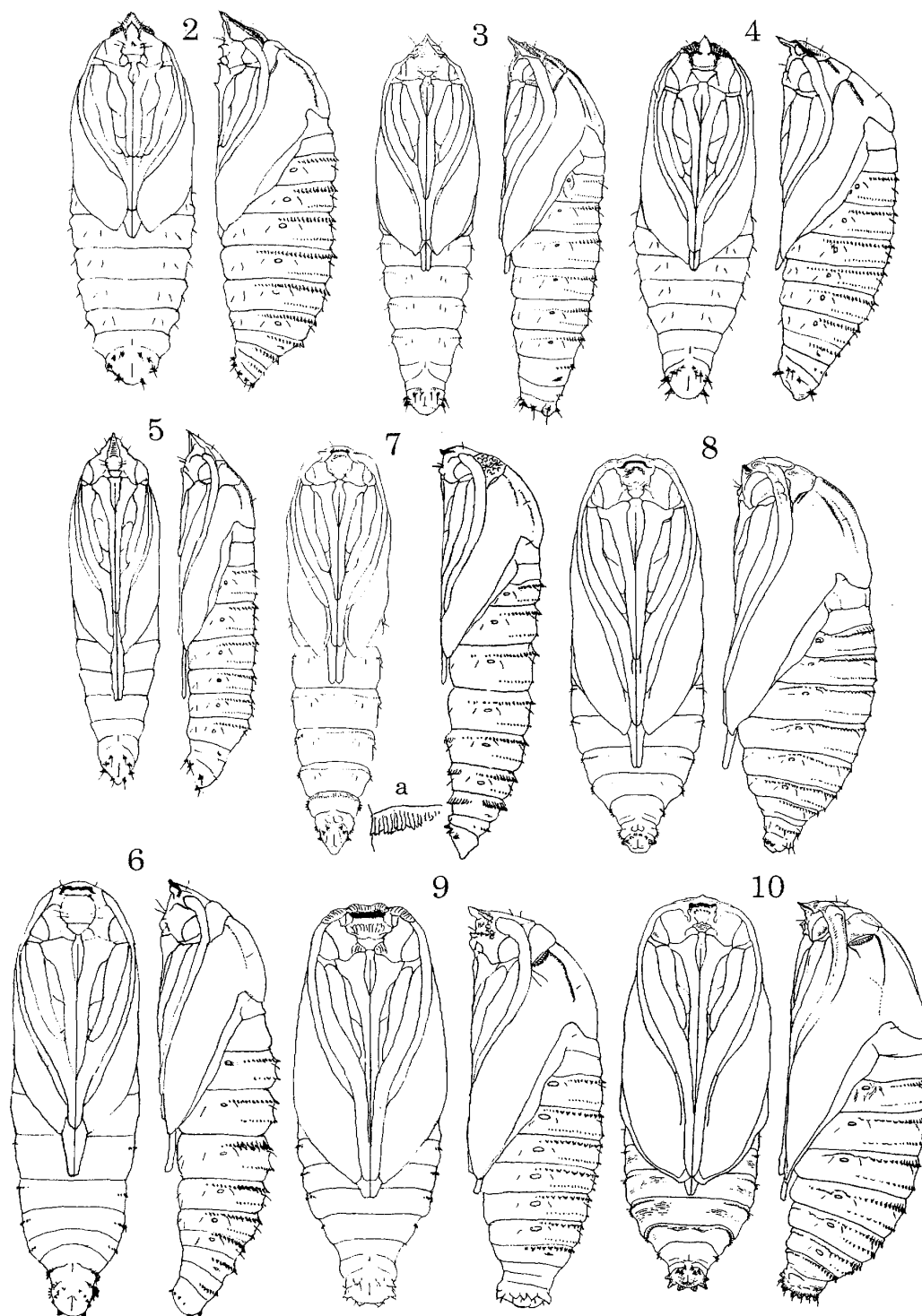
Description of the genera

Subfamily Tinthiinae

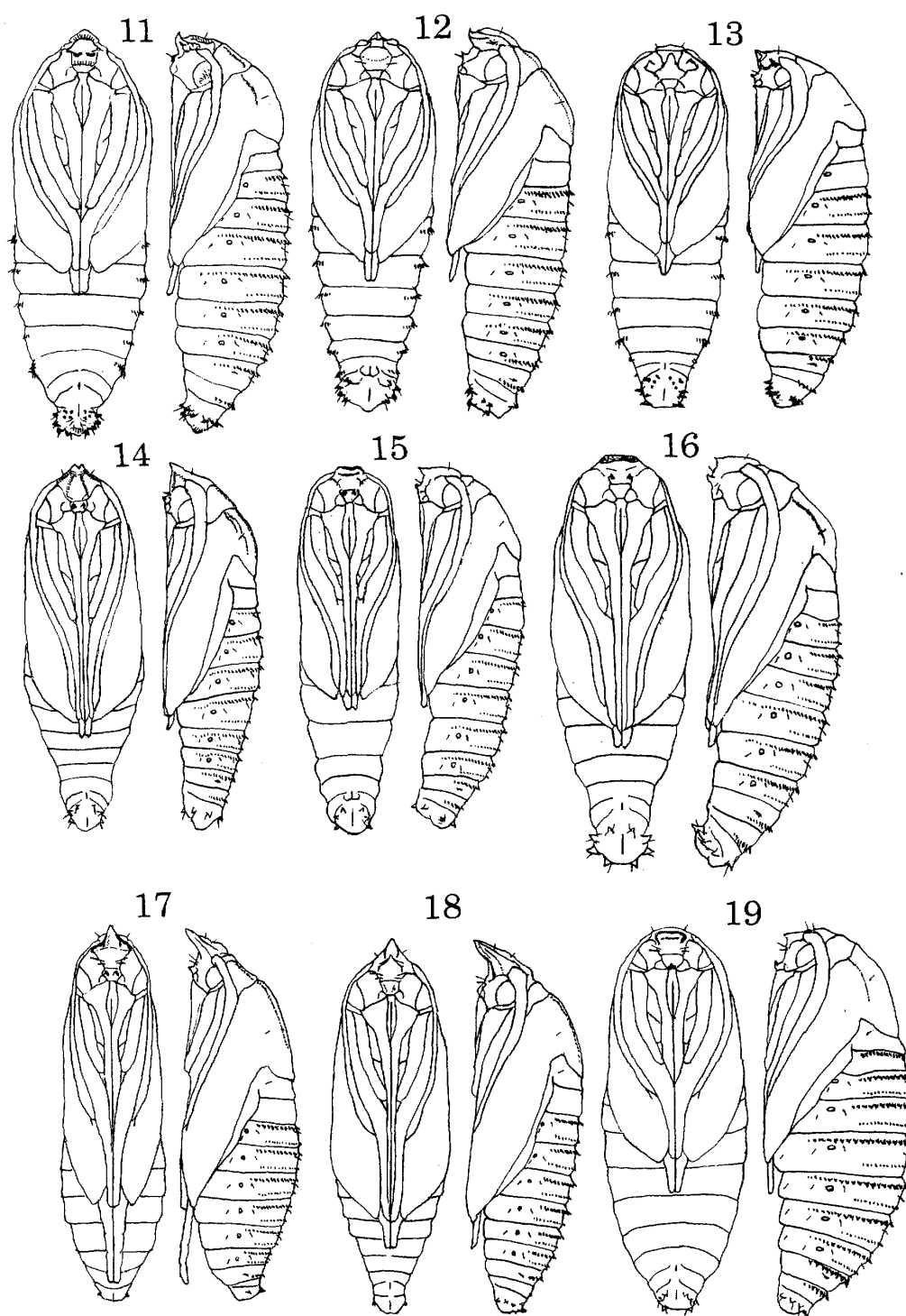
Tribe Similipepsini

Milisipepsis Gorbunov and Arita

Cylindrical. Frontal process relatively large; labial palpus somewhat long; maxilla reaching seven ninths the length to apex of wing and situated between tips of antenna and mesothoracic leg, proximo-lateral corner never touching maxillary palpus; maxillary palpus small; antenna extending midway between apices of maxilla and prothoracic leg, proximal end appearing from more cephalad than in most pupae; ridged notaulix furrows present on mesothorax; prothoracic leg reaching half the length to apex of wing; mesothoracic legs ending slightly before apex of wing; metathoracic leg visible for a considerable distance and reaching 6th abdominal segment; forewing extending to 4th abdominal segment; hindwing hidden under forewing at spiracular level of 3rd abdominal segment; spiracle circular,



Figs 2-10. Pupae of Japanese Sesiidae. 2. *Pennisetia fixseni* (Leech). 3. *Trichocerota esakii* (Yano). 4. *T. constricta* (Butler). 5. *Milisipepsis takizawai* (Arita and Špatenka). 6. *Paranthrene tabaniformis* Rottemburg. 7. *Nokona* (*Nokona*) *regalis* (Butler) (a: thin claw-like thorns row on 8th abdominal segment). 8. *Nokona* (*Aritasesia*) *pernix* (Leech). 9. *Melittia sangaica* (Moore). 10. *M. inouei* Arita and Yata.



Figs 11–19. Pupae of Japanese Sesiidae. 11. *Sesia yezoensis* (Hampson). 12. *Scasiba scribai* (Bartel). 13. *S. rhynchioides* (Butler). 14. *Synanthedon multinarsus* (Špatenka and Arita). 15. *S. tenue* (Butler). 16. *S. hector* (Butler). 17. *Macrocesia longipes* (Moore). 18. *M. japona* (Hampson). 19. *Toleria romanovi* (Leech).

8th one rudimentary and situated more dorsad; scar of larval proleg present on 5th–6th abdominal segments; two rows of small spines born along cephalic and caudal margins of 3rd–7th abdominal segments in ♂ and 3rd–6th in ♀ but one row along cephalic margin of 8th segment in both sexes; 8th abdominal spiracle rudimentary and situated more dorsad; four pairs of scaly spines present around caudal dehiscence.

M. takizawai (Arita and Špatenka). 12 mm, yellowish brown.

The pupa was described by Arita (1990).

Tribe Pennisetiini

Pennisetia Dehne

Cylindrical and rather thick. Frontal process large, broad and both sides edged with a rugose ridge, with a black pteroid overhang; frons and base of mandible enclosed with carinate rugose ridge; a small spine present on ventro-meson of frons; labial palpus very small; maxilla ending half the length to apex of wing; antenna ending midway between apices of maxilla and mesothoracic leg; ridged notaulix furrow present on mesothorax; prothoracic leg reaching level of tip of maxilla; mesothoracic legs ending midway between tip of maxilla and apex of wing, apical portion meeting on meson; metathoracic leg fully visible; forewing extending to 4th abdominal segment; hindwing hidden under forewing at spiracular level of 3rd abdominal segment; scar of larval prolegs on 5th–6th abdominal segments; two rows of small spines born along cephalic and caudal margins of 3rd–7th abdominal segments in ♂ and 3rd–6th in ♀ but one row along cephalic margin of 2nd, 8th and 9th segments in ♂ and of 2nd, 7th–9th segments in ♀; abdominal spiracle circular, 8th one vestigial and situated more dorsad; five pairs of scaly spines present around caudal dehiscence.

P. fixseni (Leech). 23 mm, brown.

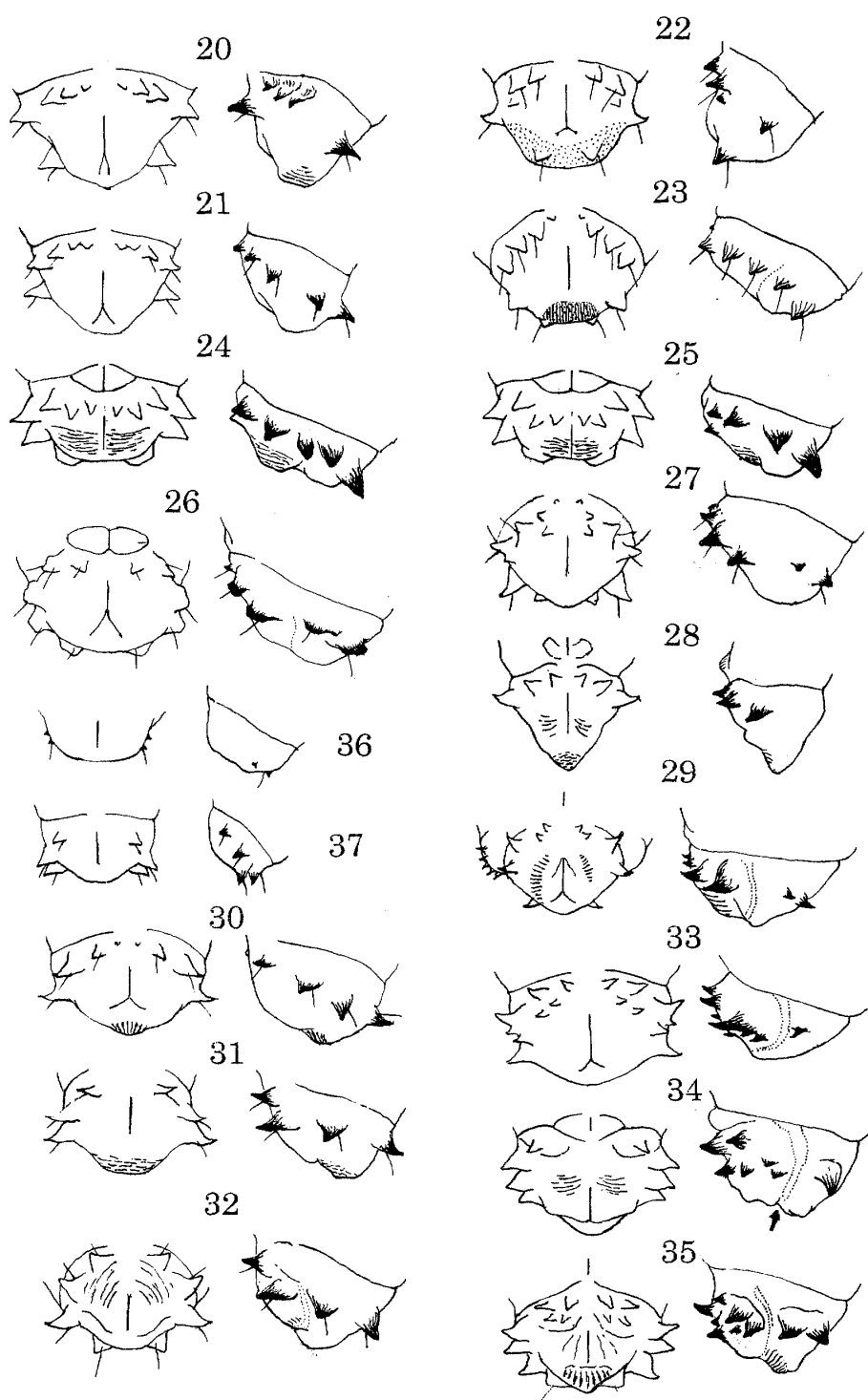
Tribe Tinthiini

Trichocerota Hampson

Longitudinal fusiform. Frontal process sharp, spine-like, protruding ventro-cephalad, both sides with black pteroid overhang; frontal piece enclosed with carinate rugose ridge; clypeo-labrum piece trapezoidal; labial palpus relatively large; maxilla ending two thirds the length to apex of wing, proximo-lateral corner touching maxillary palpus; antenna extending slightly beyond tip of maxilla; notaulix ridged furrow present on pro- and mesothorax; prothoracic leg reaching half the length to apex of wing, mesothoracic legs ending slightly before apex of wing, apical portion meeting on meson; metathoracic leg fully visible; forewing extending to cephalic margin of 5th abdominal segment; hindwing hidden under forewing at cephalic margin of 4th abdominal segment; two rows of small spines born along cephalic and caudal margins of 2nd–8th abdominal segments (a very short caudal row) in ♂ but 2nd–7th segments in ♀, but one row along cephalic margin of 9th segment in ♂ and of 7th–9th segments in ♀; abdominal spiracle circular, 8th one vestigial and situated more dorsad; two pairs very small of and three pairs of scaly spines born around caudal dehiscence.

Key to the species

1. Frontal process shaped like a broad triangle in ventral view; carinate rugose ridge running along base of antenna; antenna ending just short of tip of maxilla; metatho-



Figs 20-37. Caudal end of sesiid pupae, ventral and lateral views. 20. *Trichocerota esakii* (Yano). 21. *T. constricta* (Butler). 22. *Milisipepsis takizawai* (Arita and Špatenka). 23. *Pennisetia fixseni* (Leech). 24. *Melittia sangaica* (Moore). 25. *M. inouei* Arita and Yata. 26. *Toleria romanovi* (Leech). 27. *Paranthrene tabaniformis* Rottemburg. 28. *Nokona* (*Aritasesia*) *pernix* (Leech). 29. *N. (Nokona) regalis* (Butler). 30. *Synanthedon multinarsus* Špatenka and Arita. 31. *S. tenue* (Butler). 32. *S. hector* (Butler). 33. *Scasiba rhynchioides* (Butler). 34. *S. scribai* (Bartel) (arrow shows the scar of separated line between anal leg and anal shield of larva). 35. *Sesia yezoensis* (Hampson). 36. *Macroclesia longipes* (Moore). 37. *M. japona* (Hampson).

- racic leg visible for some distance; two pairs of scaly spines on dorsal part of 10th abdominal segment; 11 mm, dark brown.....*constricta* (Butler)
- Frontal process shaped like a narrow beak in ventral view; carinate rugose ridge running along base of antenna and frontal suture; antenna reaching slightly beyond tip of maxilla; metathoracic leg only visible for a short distance; one pair of scaly spines on dorsal part of 10th abdominal segment; 15 mm, brown.....*esakii* (Yano)

A rough figure of *T. constricta* (Butler) was submitted by Saito (1960).

Subfamily Sesiinae

Tribe Sesiini

Synanthedon Hübner

Cylindrical. Frontal process generally relatively small, horizontal; a pair of hooked spines on frons; labial palpus relatively large; maxilla reaching apex of wing, proximo-lateral corner touching maxillary palpus; antenna ending slightly short of tip of mesothoracic leg; notaulix furrows present on mesothorax; forewing expanded to 5th abdominal segment; hindwing hidden under forewing on 4th abdominal segment; prothoracic leg reaching half the length to apex of wing; mesothoracic leg ending at apex of wing; metathoracic leg visible for a short distance; small spines consisting of one row along cephalic margin of 2nd, 8th and 9th abdominal segments in ♂ and 2nd and 7th in ♀ but two rows along cephalic and caudal margins of 3rd–7th segments in ♂ and 3rd–6th in ♀; 8th abdominal spiracle rudimentary and situated more dorsad; four pairs of scaly spines (two pairs on ventral area and two pairs on dorsal one) born around caudal dehiscence.

Key to the species

1. Frontal process large and upturned, the excavated apex narrow; adfrontal suture indistinct; pair of frontal spines smaller; ridgy notaulix furrow indistinct; 11 mm, brown.....*multitarsus* Špatenka and Arita
- Frontal process small and protruding forwards, never with excavated apex; adfrontal suture distinct; pair of frontal spines larger; ridged notaulix furrow distinct..... 2
2. Hindwing hidden under forewing at caudal margin of 4th abdominal segment; mesothoracic leg reaching tip of maxilla.....3
- Hindwing hidden under forewing on 3rd abdominal segment; mesothoracic leg ending just before tip of maxilla; 10 mm, pale brown.....*formicaeformis* (Esper)
3. Antenna reaching tip of mesothoracic leg; hindwing hidden under forewing at spiracular level of 4th abdominal segment; 11 mm, yellowish brown.....*tenue* (Butler)
- Antenna ending slightly before tip of mesothoracic leg; hindwing hidden under forewing at caudal margin of 4th abdominal segment; 10 mm, pale brown.....*hector* (Butler)

S. multitarsus Špatenka and Arita was described by Arita *et al.* (1993).

Sesia Fabricius

Robust. Longitudinally fusiform. Frontal process horizontal and protruding upwards; carinate rugose ridge running radially on frons; labial palpus relatively large; maxilla hidden under mesothoracic leg at three quarters the distance to apex of wing, proximo-lateral corner touching maxillary palpus; antenna ending slightly beyond tip of maxilla; prothoracic legs ending just before tip of maxilla, meeting on meson at extremity; mesothoracic legs extending to apex of wing, apical portion meeting on meson; metathoracic leg visible for quite

a long distance; femur of prothoracic leg, coxa of mesothoracic leg and coxa of metathoracic leg visible between maxilla and prothoracic leg; forewing extending to caudal margin of 4th abdominal segment; hindwing hidden under forewing on cephalic portion of 4th abdominal segment; small spines consisting of one row along cephalic margin of 8th and 9th abdominal segments in ♂ and 7th, 8th and 9th in ♀ but two rows along cephalic and caudal margins of 2nd–7th segments in ♂ and 2nd–6th in ♀; 8th abdominal spiracle vestigial and situated more dorsad than the other segments; 10th segment separated into dorsal and ventral parts, four pairs of scaly spines and two pairs of micro spines born on ventral and two pairs of scaly spines on dorsal part.

S. yezoensis (Hampson), 23 mm, brown.

The pupa of *yezoensis* (Hampson) was recorded by Arita *et al.* (1992).

Scasiba Matsumura

Closely allied to *Sesia* Fabricius and only distinguishable as follows. Cylindrical. Frontal process longitudinal; a pair of minute spines present on frons; antenna ending at tip of maxilla; prothoracic legs ending slightly before tip of maxilla, apex never meeting on meson; mesothoracic leg ending slightly short of apex of wing; coxa of metathoracic leg disappearing between maxilla and prothoracic leg; hindwing hidden under forewing near caudal margin of 4th abdominal segment; row of small spines born on abdominal segments as in the preceding genus; 8th abdominal spiracle rudimentary and situated more dorsad; six or more pairs of scaly spines born on ventral part and one pair on dorsal part of 10th abdominal segment.

Key to the species

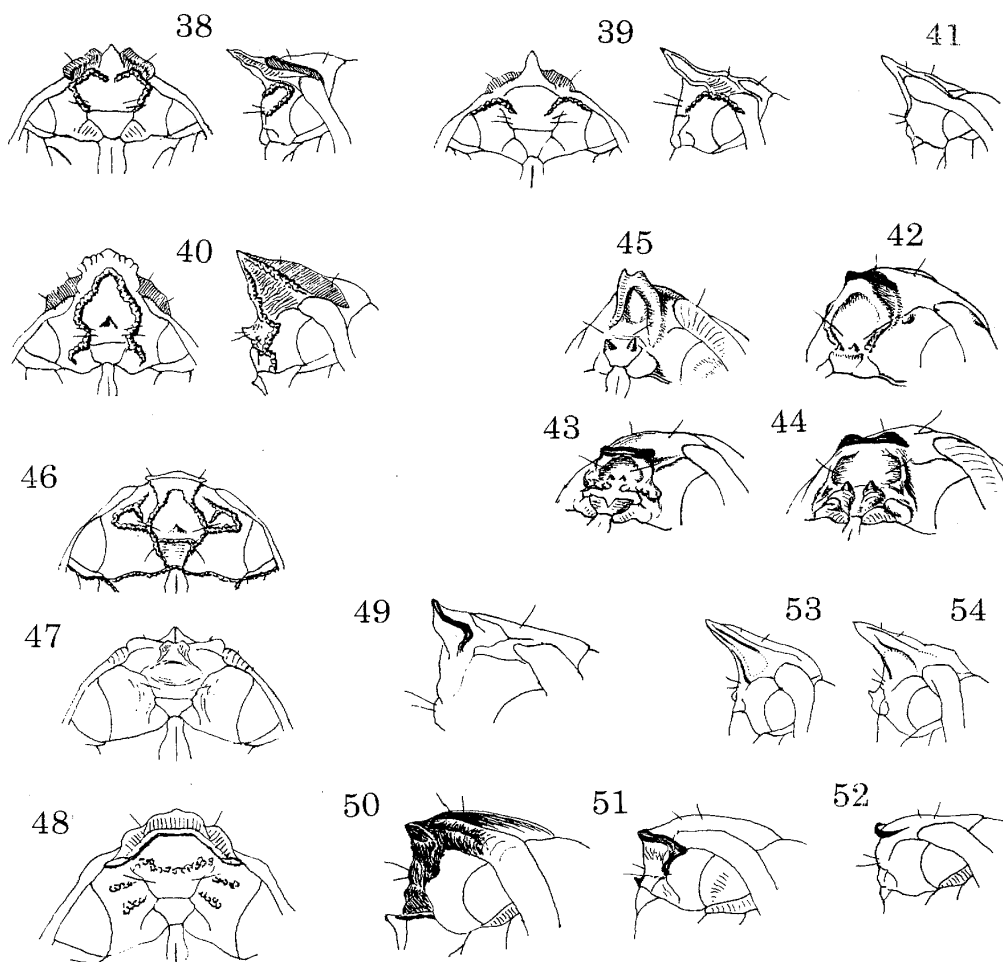
1. Frons depressed in a circular pattern; carinate rugose ridge never running onto frons; frontal spine large, protruding upwards; labial palpus somewhat short; proximo-lateral corner of maxilla touching maxillary palpus; forewing extending to 3rd abdominal segment; 18 mm, brown *scribai* (Bartel)
- Frons rather swollen; carinate rugose ridge running irregularly onto frons; frontal spine smaller than that of *scribai* Bartel; labial palpus of normal size; proximo-lateral corner of maxilla never touching maxillary palpus; forewing extending to 4th abdominal segment; 21 mm, yellowish brown *rhynchioides* (Butler)

Tribe Paranthrenini

Paranthrene Hübner

Robust. Fusiform. Frontal process small, and less sharp; front-labrum not raised; maxilla reaching five eighths the length to apex of wing, proximo-lateral corner extending laterally and attached to maxillary palpus; antenna ending mid way between tips of maxilla and mesothoracic leg; spiracular callosity never remarkable; prothoracic leg reaching half the distance to apex of wing; mesothoracic legs ending slightly short of apex of wing, apical portion meeting on meson; metathoracic leg appearing relatively long; hindwing hidden under forewing at cephalic margin of 4th abdominal segment; small spines consisting of one row along cephalic margin of 7th, 8th and 9th abdominal segments and two rows along cephalic and caudal margins of 2nd–6th segments in ♀; 8th abdominal spiracle vestigial and situated more dorsad; six scaly pairs of spines situated around caudal dehiscence.

P. tabaniformis Rottemburg. 17 mm, yellowish brown (only one exuvia examined).



Figs 38–52. Head of sesiid pupae. 38–40. Showing ragged ridge of Tinthiin pupae. 38. *Trichocerota esakii* (Yano). 39. *T. constricta* (Butler). 40. *Pennisetia fixseni* (Leech) (38–40. Ventral and lateral views, showing appearance of carinated ragged ridge). 41. *Milisipepsis takizawai* (Arita and Špatenka), lateral view. 42. *Synanthedon tenue* (Butler). 43. *S. formicaeformis* (Esper). 44. *S. hector* (Butler). 45. *S. multinarsus* Špatenka and Arita (42–45. Ventro-lateral view, showing frontal process and concave shape of frons). 46. *Scasiba rhynchioides* (Butler). 47. *S. scribai* (Bartel). 48. *Sesia yezoensis* (Hampson) (46–48. Ventral view, showing appearance of carinated ragged ridge of *Scasiba* and *Sesia*). 49. *Paranthrene tabaniformis* Rottentburg, lateral view. 50. *Toleria romanovi* (Leech). 51. *Nokona* (*Aritasesia*) *pernix* (Leech). 52. *Nokona* (*Nokona*) *regalis* (Butler) (50–52. Lateral view, showing sclerotized area forced from frontal process). 53. *Macrocelesia japona* (Hampson). 54. *M. longipes* (Moore) (53–54. Lateral view, showing shape of frontal process).

Nokona Matsumura

According to Toševski and Arita (1992), this genus comprises three groups. The pupae of *regalis* (Butler) and *pernix* (Leech), however, differ conspicuously from each other, and are therefore treated tentatively as belonging to separate subgenera in this paper.

Stout or prolonged fusiform. Frontal process similar to that of *Paranthrene*; maxilla reaching two thirds the distance to apex of wing, proximo-lateral corner extending laterally and attached to maxillary palpus; antenna extending slightly beyond tip of maxilla; ridged no-

taulix furrow present on mesothorax; prothoracic leg ending slightly before tip of maxilla; mesothoracic legs extending to or falling slightly before apex of wing, apical portion meeting on meson; metathoracic leg visible over a relatively long distance; forewing extending to 4th abdominal segment; hindwing hidden under forewing at caudal margin of 3rd abdominal segment; small spines consisting of one row along cephalic margin of 8th and 9th abdominal segments in ♂ and 7th, 8th and 9th in ♀ but two rows along cephalic and caudal margins of 2nd–7th segments in ♂ and 2nd–6th in ♀; a row of thin claw-like thorns along cephalic margin of 6th–8th abdominal segments ventrad in *regalis* Butler; 8th abdominal spiracle vestigial and situated more dorsad; three or four pairs of scaly spines present around caudal dehiscence.

Key to the species

1. Prolonged fusiform; head narrowed; frontal process quite large; a pair of small spines absent on labial palpus; maxilla ending slightly before tip of antenna; mesothoracic leg falling slightly before apex of wing; metathoracic leg reaching 4th abdominal segment; a thin claw-like row of thorns along cephalic margin of 6th–8th abdominal segments ventrad; three pairs of scaly spines on 10th abdominal segment ventrad; caudal end of body obovate; 20 mm, brown, abdomen yellowish brown
.....**subgenus *Nokona regalis* (Butler)**
- Fusiform but somewhat stout; head rounded; frontal process very small; a pair of small spines present on labial palpus; maxilla reaching midway between tips of prothoracic leg and antenna; mesothoracic leg extending to apex of wing; metathoracic leg reaching 5th abdominal segment; two pairs of scaly spines on dorsal part and four pairs on ventral part of 10th abdominal segment; tapered from 7th abdominal segment towards caudal end of body; 15 mm, dark brown
.....**subgenus *Aritasesia* nov.* *pernix* (Leech)**

The species from Japan belonging to the new subgenus are *pernix* (Leech) and *rubra* Arita and Tošovskí.

N. regalis Butler was illustrated by Nakamura (1980).

Toleria Walker

Robust. Allied to *Nokona (Aritasesia) pernix* (Leech) and can only be distinguished by the presence of a row of small spines on the 1st abdominal segment and the shape of the scaly spines born on the 10th abdominal segment.

Fusiform but somewhat stout. Frontal process transverse and both sides expanded to clypeus; a pair of upward-pointing small spines present on proximal portion of labial palpus; mandible somewhat prolonged; maxilla reaching five eighths the length to apex of wing; antenna ending slightly beyond tip of maxilla, apical portion not clavate; ridged notaulix furrow visible on mesothorax; forewing extending to 4th abdominal segment; hindwing hidden under forewing at caudal margin of 3rd abdominal segment; prothoracic leg ending slightly before tip of maxilla; mesothoracic legs ending slightly before apex of wing, apical portion meeting on meson; metathoracic leg visible over a relatively long distance;

*This new subgenus (type species: *Bembecia pernix* Leech, 1889, *Proc. zool. Soc. Lond.* **1888**: 592, pl. 30, fig. 5) is distinguished from the nominotypical subgenus by the presence of an anal tuft with many hairs expanded in a fan-like shape, by the apical area of the valva not being covered with long scales; by the aedoeagus being shorter than the valva, and by the fact that the larva never attacks Vitaceae and when mature makes a tough cocoon.

one row of small spines present along cephalic margin on 1st, 8th and 9th segments in ♂ and 1st, 7th, 8th and 9th in ♀ but two rows on 2nd–7th segments in ♂ and 2nd–6th segments in ♀; 8th abdominal spiracle rudimentary and situated more dorsad; 10th abdominal segment with three pairs of spatulate spines on ventral part and two on dorsal part.

T. romanovi (Leech). 21 mm, brown, abdomen yellowish.

The figure of this species was shown by Arita and Hirao (1991).

Tribe Melittiini

Melittia Hübner

Robust. Fusiform. Frontal process transverse, relatively small; clypeo-labrum slightly raised or prolonged; maxilla narrowing towards apex and hidden under mesothoracic leg at five sevenths the length to apex of wing, proximo-lateral corner attached to maxillary palpus; antenna reaching half the length to apex of wing; sculptured eye-piece striated; spiracular callosity very large, transverse; prothoracic leg ending two-fifths the length to apex of wing; mesothoracic leg reaching apex of wing; metathoracic leg visible for a small distance; forewing extending to 5th abdominal segment; hindwing appearing narrowly to apex of wing; two rows of small spines present on 2nd–7th abdominal segments in ♂ and on 2nd–6th segments in ♀ but one row on 8th segment in ♂ and 7th–8th segment in ♀; 8th abdominal spiracle vestigial and placed more dorsad; five or six pairs of spatulate spines present on 10th abdominal segment.

Key to the species

1. Frontal process smaller than following species; six pairs of spatulate spines born on 10th segment; 19 mm, brown, frons blackish brown *sangaica* (Moore)
- Frontal process larger than *sangaica* Moore; five pairs of spatulate spines born on 10th segment; 20 mm, brown, frons blackish brown *inouei* Arita and Yata

The pupae of this genus have been described by Arita *et al.* (1990).

Macrocesia Hampson

Longitudinal. Frontal process very large, both sides slightly concave; clypeo-labrum piece distinct, bearing a pair of minute spines or protuberances; maxilla recognized from proximal end to near apex of wing but apical portion hidden under mesothoracic leg, proximo-lateral corner attached to maxillary palpus; antenna ending half the length to apex of wing, clavate at apex; spiracular callosity not so large but noticeable; forewing extending to 5th abdominal segment; hindwing hidden under forewing at spiracular level of 3rd or caudal margin of 4th abdominal segment; prothoracic leg reaching two fifths the length to apex of wing; mesothoracic legs ending at apex of wing, apical portion meeting on meson; metathoracic leg visible over a long distance; row of small spines on abdominal segment same as that of *Melittia* Hübner but spines of 8th segment row very minute in ♀; 8th abdominal spiracle rudimentary and situated more dorsad; a few pairs of minute spines born on 10th abdominal segment.

Key to the species

1. A pair of minute protuberances present in clypeo-labrum piece; proximo-lateral corner of maxilla never touching maxillary palpus; hindwing hidden under forewing at caudal margin of 4th abdominal segment; metathoracic leg slightly long, ending on 7th abdominal segment; 10th segment with four pairs of minute spines; 12 mm,

- brown *japona* Hampson
 – A pair of minute spines present in clypeo-labrum piece; proximo-lateral corner of maxilla touching maxillary palpus; hindwing hidden under forewing at spiracular level of 3rd abdominal segment; metathoracic leg very long, extending to 8th abdominal segment; 10th segment with two pairs of minute spines; 14 mm, brown
 *longipes* Moore

The pupa of *japona* (Hampson) was described under the genus *Melittia* by Arita *et al.* (1990).

Acknowledgement

The author wishes to express his hearty thanks to Prof. Y. Arita, Faculty of Agriculture, Meijo University for the provision of a great deal of material, and also his kindness in making available literature and his acceptance of many suggestions on the classification of the Sesiidae.

References

- Arita, Y., 1990. Descriptions of the larva and pupa of *Similipepsis takizawai* Arita & Spatenka (Lepidoptera, Sesiidae). *Nota lepid.* **13**: 192–197.
- Arita, Y., Funahashi, K. and K. Fukuzumi, 1992. The immature stages of *Sesia yezoensis* (Hampson, 1919) (Lepidoptera, Sesiidae). *Bonn. zool. Beitr.* **43**: 325–331.
- Arita, Y. and K. Hirao, 1991. Systematic evaluation and description of life stages of “*Sesia*” *romanovi* (Leech) (Sesiidae). *J. Lepid. Soc.* **45**: 356–365.
- Arita, Y. and M. Ikeda, 2000. Sesiidae of Japan—“Hymenopterous mimicry clearwing moth”. *Gekkan-Mushi Books* **3**. 203 pp. Mushi-sha, Tokyo. (In Japanese)
- Arita, Y., Inomata, T. and M. Ikeda, 1994. Sesiidae of Japan. *Yadoriga* (159): 2–29 (in Japanese).
- Arita, Y., Inoue, Y. and N. Yata, 1990. The early stages of Japanese *Melittia* (Lepidoptera, Sesiidae). *Tyô Ga* **41**: 33–43.
- Arita, Y., Niimi, S. and H. Nakano, 1993. Descriptions of the larva and pupa of a clearwing moth *Synanthedon multinarsus* Špatenka and Arita (Sesiidae). *Tyô Ga* **43**: 239–244.
- Common, I. F. B., 1990. *Moths of Australia*. 535 pp., 16 pls. Melbourne Univ. Press.
- Common, I. F. B. and E. D. Edwards, 1981. The life history and early stages of *Synemon magnifica* Strand (Lepidoptera: Castniidae). *J. Aust. ent. Soc.* **20**: 295–302.
- Delgado Puchi N., 2005. Caracterización morfológica de los Sesiidae (Insecta: Lepidoptera) perforadores del fruto del cacao (*Theobroma cacao* L.), presentes en la region costera del estado Aragua, Venezuela. *Entomotropica* **20**: 97–111.
- Fibiger, M. and N. P. Kristensen, 1974. The Sesiidae (Lepidoptera) of Fennoscandia and Denmark. *Fauna Ent. Scand.* **2**. 91 pp. Scandinavian Science Press Ltd., Gadstrup, Denmark.
- Hori, H., 1934. On two gall making species of the family Aegeriidae. *Kontyû* **8**: 123–130, pls 1–2 (in Japanese).
- Mosher, E., 1916. A classification of the Lepidoptera based on characters of the pupa. *Bull. Illinois St. Lab. Nat. Hist.* 159 pp., 27 pls.
- Nakamura, M., 1980. The key for the classification of Japanese Lepidopterous pupae. *Collection of rhopalocological Papers presented for the 10th Anniversary of Takao Seminar*: 1–29. Takao Seminar, Tokyo. (In Japanese).
- Naumann, C. M., 1971. Studies on the systematics and phylogeny of Holarctic Sesiidae (Insecta, Lepidoptera). *Bonn. zool. Monographien* **1**. 190 pp., Zool. Forschungsinstitut und Museum Alexander Koenig, Bonn.
- Patočka, J., 1987. Über die Puppen der mitteleuropäischen Vertreter der Familie Sesiidae (Lepidoptera). *Acta Soc. zool. Bohemoslov* **51**: 11–38.
- Pühringer, F. and A. Kallies, 2004. Provisional checklist of the Sesiidae of the world (Lepidoptera: Ditrisia). *Mitt. Ent. Arb. gem. Salzkammergut*. **4**: 1–85.
- Saito, T., 1960. On the *Trichocerota constricta* Butler (Lepidoptera: Aegeriidae), a new stem borer of rose in Osaka Prefecture. *Publ. 5, Ent. lab. College Agr. Univ. Osaka Pref.*: 29–33 (in Japanese).

Toševski, I. and Y. Arita, 1992. A new species of the clearwing moth genus *Nokona* (Lepidoptera, Sesiidae) from Ryukyus. *Jap. J. Ent.* **60**: 619–623.

摘 要

日本産スカシバガ科の蛹(鱗翅目)(中村正直)

日本産スカシバガ科 11 属 19 種の蛹を記載, 図示し, これに基づく系統分類を行った. これらの材料は何れも野外で採集された幼虫または蛹を名城大学農学部動物学研究室において飼育し, 得られた蛹を液浸標本としたものである.

この材料に基づき本科の系統分類を試みた結果, Pühringer and Kallies (2004) の示した世界のスカシバガ科の暫定目録における成虫の分類体系と次の点を除き極めてよく一致することがわかった. 異なる点は 1. *Synanthedon* を独立の族 *Synanthedonini* に含めず *Sesiini* の属としたこと. 2. *Toleria* を *Cissuvorini* 族に入れず, *Paranthrenini* 族に含めたこと.

この *Toleria romanovi* (Leech) の蛹は極めて特異なもので, 第 1 腹節に微棘列を有する点を除くと *Nokona pernix* (Leech) の蛹と殆んど区別出来ない程である. *Nokona* 属は幼虫がブドウ科を食害するものとアカネ科の茎に潜るものとでは形態的にかなりの差異が認められるので, 本文では互いに別亜属とし後者に対し新たに亜属 *Aritasesia* を設けることとした.

スカシバガの蛹の頭部では前頭(時には大腮も)を囲むようにごつごつとした隆起線が認められる種が多いが, これは他の科の蛹には認められない特異な形態である. また尾端の形状は原始的で, 蛹化に際し幼虫の肛上板と尾脚とが一体となって変態しているため, 尾端の背方部分はハマキガ科以上の高等な鱗翅類にみられるように大きくはなく, 両部分が互いに頭尾方ではなく腹背方に位置している. 従って尾突起 (cremaster) の形成はみられないが, シャクガ科などにみられる側溝 (lateral groove) に相当する, 両部分を分かつ線の跡を認めることは出来る. また幾つかの種で尾端背部に粗状をした部分が認められるが, これは成虫において尾端絨毛の生じる部分であろうと推定される.

(Accepted March 5, 2007)